

ECHIURANS FROM AUSTRALIA (ECHIURA)

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Seventeen species of echiurans are recorded from Australia of which nine are redescribed, and none are new. One, *Anelassorhynchus porcellus adelaidensis*, is given new status. *Listriolobus bulbocaudatus* Edmonds, 1963 is now considered a junior synonym of *L. brevirostris* Chen & Chen Chang, 1958, *Ochetostoma myersae* Edmonds, 1963 a junior synonym of *O. baroni* Greeff, 1879 and *Austrobonellia mjobergi* (Fischer, 1921) a junior synonym of *Pseudobonellia bluterina* Johnston & Tiegs, 1919. A key to the Australian species is given.

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Echiurans are soft-bodied, protostomous, coelomate, worm- to sausage-shaped, marine invertebrates that resemble annelids and sipunculans. Because they are largely subtidal and occur in burrows and protected places echiurans are not always easy to find. They have, however, been collected in tropical, temperate and polar seas and are known from the littoral to the ultra-abyssal regions of the oceans. More than 150 species have been described.

Records of Australian echiurans are few and scattered (Haswell 1885, Whitelegge 1899, Augener 1903, Hedley 1906, Dakin 1916 and 1952, Fischer 1919 and 1921, Johnston & Tiegs 1919 and 1920, Monro 1931, Edmonds 1960, 1963, 1966 and 1982, Nielsen 1963, Dartnall 1970 and 1976) and only 16 species have so far been reported, of which three are well known. In Australia echiurans have been found in burrows in mud and sand, in limestone rocks and in coral, in tangled roots of sea-grasses, under stones and in cracks and fissures in rocks. Some have been dredged. The best known Australian echiurans (and ones that can be readily collected) are *Metabonellia haswelli*, *Anelassorhynchus porcellus adelaidensis* and *Ochetostoma australiense*. Scuba divers report the presence of large numbers of the first in shallow water at Encounter Bay, S.A., between Wright I. and the Bluff and from the islands comprising the Banks Group in Spencer Gulf, S.A. and of the second species from Coobowie and Edithburg in St Vincent Gulf, S.A. Large numbers of *O. australiense* occur at Caloundra and Dunwich, Qu., the species feeding from the surface of intertidal mud flats at low water. In other parts of the world they have also been found in the empty shells of molluscs and in sand dollars. Most of the specimens examined in the present study were found intertidally by collectors or subtidally by divers and are now in the collections of State Museums.

The classification used in this paper is that outlined by Stephen & Edmonds (1972), which in turn is based on that of Fisher (1946).

LIST OF AUSTRALIAN ECHIURANS

The species marked '*' have not been examined by the author. Records of species marked '?' are considered doubtful.

Family Bonelliidae

- Metabonellia haswelli* (Johnston & Tiegs)
- Pseudobonellia bluterina* Johnston & Tiegs
- ?* *Archibonellia michaelsoni* Fischer
- * *Zenkevitchiella brevirostris* Murina
- * *Sluiterina alba* Murina
- * *Vitjazema ultraabyssalis* Murina
- * *Protohonellia papillosa* Murina

Family Echiuridae

- Anelassorhynchus porcellus porcellus* Fisher
- Anelassorhynchus porcellus adelaidensis* Edmonds n. status.
- ?* *Anelassorhynchus vegrandis* (Lampert)
- Arhynchite hiscocki* Edmonds
- Listriolobus brevirostris* Chen & Yeh Chen-Chang
- ?* *Listriolobus sorbillans* (Lampert)
- Ochetostoma baroni* (Greeff)
- Ochetostoma australiense* Edmonds
- Thalassema sydneyense* Edmonds

Family Ikedaidae

- Ikeda* sp.

The following abbreviations are used in this paper: AMS (Australian Museum, Sydney), MV (Museum of Victoria, Melbourne), SAM (South Australian Museum, Adelaide), WAM (Western Australian Museum, Perth), TMH (Tasmanian Museum, Hobart), N.S.W. (New South Wales), Qu. (Queensland), S.A. (South Australia), Tas. (Tasmania), Vic. (Victoria), W.A. (Western Australia.). The anatomy of a 'generalised' echiuran is shown in Fig. 1.

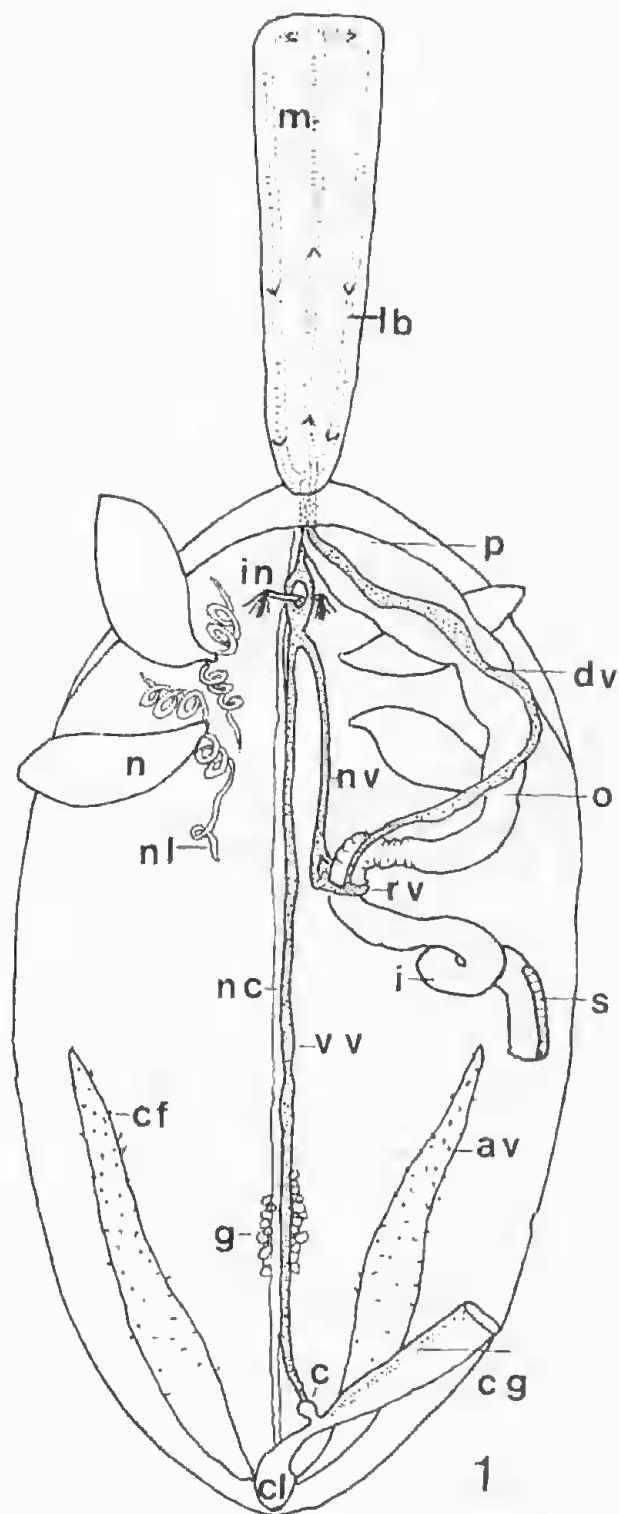


FIGURE 1. A generalized diagram to show some of the internal anatomy of an echiuran; dorsal view. Most of the much coiled intestine has been omitted. av, anal vesicle; c, caecum; cf, ciliated funnel; cg, ciliated groove; cl, cloaca; dv, dorsal vessel; g, gonad; i, intestine; in, interbasal muscle; lb, lateral vessel; m, median vessel; n, nephridia; nc, nerve cord; nl, nephrostomal lips; nv, neurointestinal vessel; o, oesophagus; p, pharynx; rv, ring vessel; s, siphon; vv, ventral vessel.

KEY TO GENERA OF AUSTRALIAN ECHIURANS

The doubtful genus *Archibonellia* has not been included in the key; it would key near *Pseudobonellia*.

1. Proboscis bifid 2
 Proboscis not bifid 3
2. One nephridium, with distally placed, stalked nephrostome *Metabonellia*
 Two nephridia with a small sac carrying a male between them *Pseudobonellia*
3. Longitudinal musculature of body wall grouped into bands 4
 Longitudinal musculature of body wall not grouped into bands 6
4. Nephridia less than 10 and arranged in pairs; trunk long or short 5
 Nephridia very numerous and not in pairs; trunk very long, up to 400 mm *Ikeda*
5. Intervals between longitudinal muscle bands traversed by small bundles (fascicles) of oblique muscles *Ochetostoma*
 Intervals between longitudinal muscle bands not traversed by small bundles of oblique muscles *Listriolobus*
6. Nephrostome distal *Vitjazema*
 Nephrostome basal 7
7. Ventral setae none 8
 Ventral setae two 9
8. Anal glands long and slender; posterior region of proboscis surrounded by a collar *Zenkevitchiella*
 Anal glands bushy or feathery; posterior region of proboscis modified to form a cup... *Sluiterina*
9. Nephrostomal lips long and spirally coiled *Anelassorhynchus*
 Nephrostomal lips long or short but not spirally coiled 10
10. Anal glands tubular or sac-like 11
 Anal glands feathery or bushy *Protobonellia*
11. Proboscis with expanded or fan-like anterior extremity *Arhynchite*
 Proboscis without expanded or fan-like anterior extremity *Thalassema*

DESCRIPTION OF GENERA AND SPECIES

Genus *Metabonellia* Stephen & Edmonds

Metabonellia Stephen & Edmonds, 1972, p. 394.

Type-species: *Bonellia haswelli* Johnston & Tiegs, 1920. (*Bonellia gigas* Nielsen, 1963, which was named as type by Stephen & Edmonds (1972) is now

considered to be a junior synonym of *B. haswelli*). The genus contains only one known species.

Diagnosis

Female of medium to large size, with proboscis bifid, grooved and ciliated on ventral surface. Pale to dark green. Two ventral setae. Single nephridium with nephrostome on a short stalk placed about two-thirds of way along nephridium towards its distal extremity. Anal vesicles branching. Intestinal siphon present. Male worm-like, as long as 20 mm and without setae. Found in nephridium of female.

Metabonellia haswelli (Johnston & Tiegs) (Figs 2-4, 18)

Bonellia haswelli Johnston & Tiegs, 1920, pp. 73-76; Edmonds, 1960, pp. 95-96.

Bonellia gigas Nielsen, 1963, pp. 61-67.

Bonellia tasmanica Dartnall, 1970, pp. 69-71.

Metabonellia haswelli Stephen & Edmonds, 1972, pp. 394-395; Dartnall 1976, pp. 1041-1043; Edmonds 1982, pp. 314-316.

Holotype: AMS G1122 and paratype G1261. Type locality, Sydney Harbour, N.S.W., 'under stones just above the limit of low water'.

Previous Australian records: Johnston & Tiegs (1920), Edmonds (1960), Nielsen (1963), Dartnall (1976).

Description of female

Trunk: Medium to large, shape variable (sausage to sub-ovoid), light to dark green, length 20-80 mm (Nielsen 1963; length 80-120 mm, maximum width 40 mm). Skin smooth to rough, usually covered anteriorly and posteriorly with near circular rows of rather flattened papillae. Thickness of body wall variable, longitudinal musculature continuous.

Proboscis: Firmly attached, long, bifid and capable of great extension, maximum length in fixed specimens 260 mm. Arms short and usually of about equal length, 20-30 mm. Lateral edges tend to roll inwards, ventral surface ciliate, dorsal surface smooth.

Setae: Two, together with reserve setae, ventrally placed and posterior to mouth. Setal but no interbasal muscle present.

Alimentary Canal: Mouth at base of proboscis, canal much coiled and fastened to body wall by numerous strands of muscle. Consists of (1) foregut (divided into pharynx, oesophagus, crop and gizzard), (2) midgut (wider and longer than foregut), associated for most of its length with a collateral intestine or siphon and (3) hindgut and cloaca. Siphon tubular, of smaller diameter than

intestine and arising near beginning of midgut. A ciliated groove lies in wall of much of posterior intestine. No precloacal caecum. Faecal matter forms pellets. Anus at posterior extremity of trunk.

Nephridium: Single, attached to coelomic wall of trunk just posterior to level of setae. Size variable, depending on reproductive condition of animal. Wall of anterior and posterior regions usually thicker than thin, often transparent, middle region, which seems capable of much extension and even sacculation. Nephrostome distal, situated about three-quarters to two-thirds length of nephridium away from nephridiopore. Nephrostomal lips frilled or crenated, situated at end of short stalk. Nephridium holds eggs and/or a male (two males in one specimen). Eggs develop in coelom along a mesentery associated with ventral blood vessel and nerve cord. Diameter of largest eggs 0.50-0.55 mm.

Vascular System: Thin walled ventral blood vessel. Single neurointestinal vessel, arising posteriorly from two short arms on each side of anteriormost region of intestinal siphon, joins ventral vessel in anterior half of trunk. Thin walled dorsal vessel fuses with intestine near posterior extremity of foregut. Anterior continuations of ventral and dorsal vessels extend into proboscis. Neurointestinal vessel often vesiculated or superficially roughened and coloured dark yellow to orange.

Anal Vesicles: Two, much branched, tufted and each a complex of tubes and tubules. Johnston & Tiegs (1920, p. 75) described them thus: 'Into the cloaca open two anal vesicles Into each open about 15 tubules, some quite short, others much longer. These tubes give off smaller or larger numbers, at times very large numbers, of secondary nephridial [?] excretory tubes, each ending in a narrow neck which bears a circular disc with the nephrostome opening in its centre. The disc is composed of a ring of compressed elongated cells, with strongly staining nuclei and fringed with a ring of cilia'. In larger specimens the vesicles are larger and the branches more tufted.

Description of male (based on four stained and mounted specimens)

Located in nephridia of females but not permanently attached like male of *Pseudobonellia biuterina*. Long, thin or flat but swollen or rounded anteriorly, tending to taper posteriorly; largest about 20 mm long, maximum width 1.2, lacking setae. Body wall very thin. Outline of what might be a rudimentary gut runs through most of animal; body cavity contains developing sperm morulae. Cilia on some regions of body surface.

No males were found by Johnston & Tiegs (1920). The male of *Bonellia gigas* Nielsen, 1963 is 19 mm long and 0.5-1.0 mm wide, lacking setae but

possessing a posterior sucker or clasper. The male of *Bonellia tasmanica* Dartnall, 1970 is 7 mm long, 0.8 mm wide, tapering posteriorly and lacking both setae and clasper.

Systematics

Bonellia gigas Nielsen, 1963, described from a very large bonelliid collected at Western Port, Vic., was considered to be different from *B. haswelli* chiefly because it lacked an intestinal siphon. Although I have not been able to dissect the type of *B. gigas*, I have dissected one specimen from Port Phillip Bay and another from Flinders. Both have siphons. Further, Fig. 2 of Nielsen, 1963, clearly shows a siphon attached to part of the gut, especially the posterior part. Nielsen apparently mistook the siphon for a continuation of the neurointestinal vessel and labelled it 'intestinal blood vessel'.

Dartnall (1970) described *B. tasmanica* from northern Tasmania, arguing that it differed from *B. haswelli* because it lacked a siphon and from both *B. haswelli* and *B. gigas* because its nephridia were sacculated. It is probable that what Dartnall described as 'an intestinal vessel, which runs closely along the wall of the intestine for about the posterior two thirds of its length' and then 'leaves the gut and joins the ventral vessel' is in part a siphon and in part a neurointestinal vessel. The sacculated condition of the nephridium of *B. tasmanica* is a doubtful character and was probably caused by temporary muscular contractions of the organ at the time of fixation. In one specimen from S.A. the thin walled part of the nephridium is constricted near its middle so as to form two sacs.

From a study of male and female specimens of *B. haswelli*, *B. gigas* and *B. tasmanica* it is concluded that the three species are synonymous, the first name having priority. Stephen & Edmonds (1972) transferred the species to a new genus *Metabonellia* on account of the distal position of its nephrostome. Johnston & Tiegs' specimens from N.S.W. were small but Nielsen's from Victoria were very large.

Specimens examined and localities

New South Wales: Fairlight (near Manly) (1) AMS W5612 and (3) AMS W4702 (two of these clearly show the relationship between the neurointestinal vessel and the siphon); Camp Cove, Sydney Harbour (1) AMS W8703; locality unknown (1) SAM E1404.

Victoria: Port Phillip Bay near Port Arlington (2) MV coll. and at Mornington (1) MV coll.; Flinders, Western Port Bay, SAM E1400 (1) and type male and female of *B. gigas* MV G2696 and 2697; Port Phillip Survey area 31 'inside buoy' (1) SAM E1407.

Tasmania: Jacobs Boat Harbour (north Tasmania), paratype of *B. tasmanica*, TM K226.

South Australia: Spencer Gulf - Boston I. (near Port Lincoln) (2) SAM E1401; at following islands in Banks Group, Marum I. (3) SAM E1475, (3) SAM E1492, Lusby I. (1) SAM E1488, Langton I. (1) SAM E1504, Hareby I. (1) SAM E1508; St Vincent Gulf - Edithburg jetty (near base of outer piles) (2) SAM E1403, (1) SAM E1457, (3) SAM 1458 (3) SAM E1502; Marino Rocks (3) SAM E1406; Aldinga Reef (1) SAM E1402; Victor Harbour - near Rosetta Head (3) SAM E1451, (3) SAM E1483, (3) SAM E1466, (5) SAM E1451, (3) SAM E1490 and near Whalers Wharf (3) SAM E1474; St Francis I. (Nuyts Archipelago) (4) SAM 1469.

Western Australia: Mistaken I. (King George Sound) (1) WAM 37-85; Garden I. (1) WAM 10-73; off Carnac I. (1) WAM 71-75; off Dunsborough (1) WAM 9-73; Houtman Abrolhos (At N. end of Morley I., Easter Group) (1) WAM 279-85.

Distribution

Known from south-western, southern and south-eastern Australia, from the Abrolhos I. in Western Australia to Sydney Harbour in New South Wales. Usually collected subtidally, occasionally intertidally. No records other than from Australia.

Habitat

In South Australia individuals of this species live in crevices between rocks and under rocks in sheltered, calmer water where there is a deposition of fine, muddy silts, such as occurs on the lee side of the Bluff at Victor Harbour and at Edithburg jetty on Yorke Peninsula. The greatest concentration appears to be at the perimeter of the rubble-reef area, especially where the latter abuts open flat where sea-grasses grow. The proboscis extends only at night and then over the bottom adjacent to the burrow for a radius of about one metre' (N. Holmes pers. comm.).

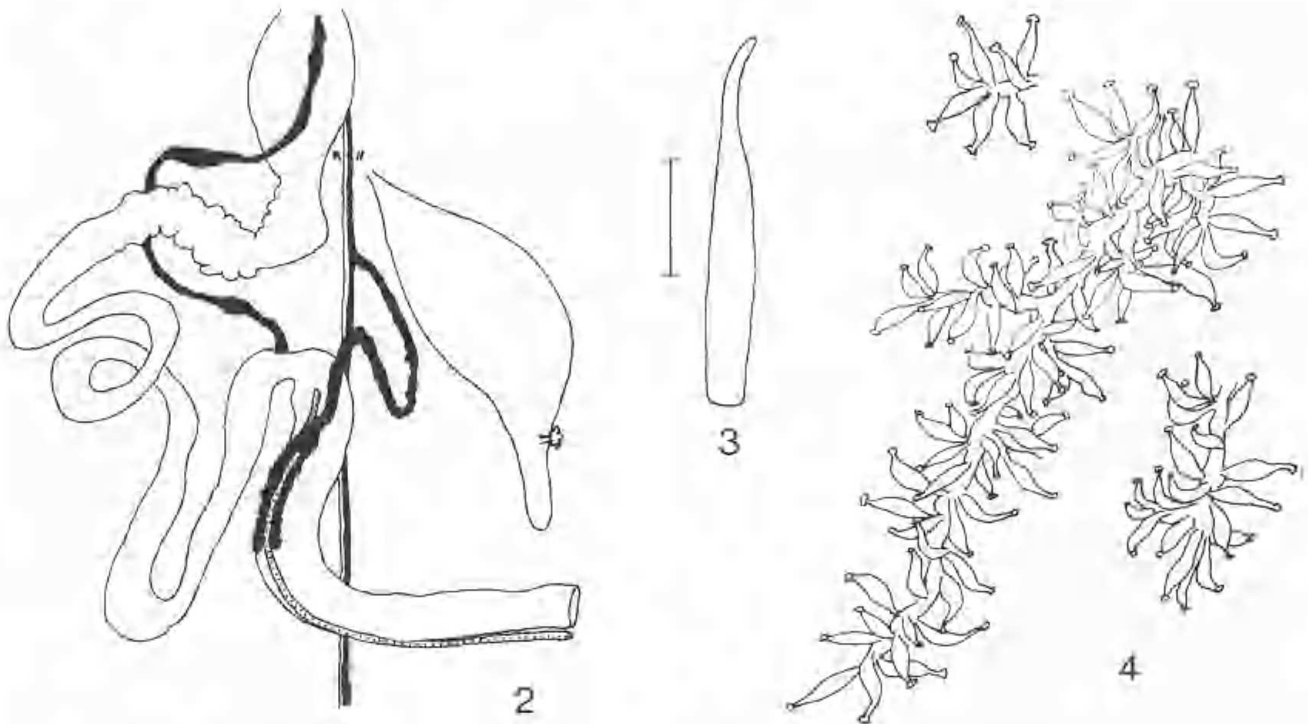
Genus *Pseudobonellia* Johnston & Tiegs

Pseudobonellia Johnston & Tiegs, 1919, pp. 213-230; Stephen & Edmonds, 1972, p. 401; Datta Gupta 1976, p. 115.

Type-species: *Pseudobonellia bulterina* Johnston & Tiegs

Diagnosis

Female with bilid proboscis. Trunk with two ventral setae. Two nephridia (gonoducts) with distally placed nephrostomes; nephrostomal lips crenated. Anal vesicles branching. Male carried in small blind tube that projects into coelom between nephridiopores. Type species: *Pseudobonellia*



FIGURES 2-4. *Metabonellia haswelli*. 2, anterior region dissected. 3, seta (scale line = 0.3 mm). 4, portion of anal vesicle.

biuterina Johnston & Tiegs, 1919. The genus contains only one species.

***Pseudobonellia biuterina* Johnston & Tiegs**
(Figs 5-8, 19)

Pseudobonellia biuterina Johnston & Tiegs, 1919, pp. 213-230, pls 9-11; Monro 1931, p. 33; Fisher 1948a, p. 856; Edmonds 1960, pp. 96-97, fig. 5; Stephen & Edmonds 1972, p. 401.

Archibonellia mjobergi Fischer, 1921, pp. 6-8; *Austrobonellia mjobergi* Fisher, 1948a, 856; Edmonds 1960, p. 97.

Holotype: AMS G477; type locality, North West Islet (Capricorn Group), Qu.

Description of female

Trunk: Small, maximum length 23 mm (mostly 6-14), maximum width 3-6, pyriform, sub-ovoidal to globular, pale to dark green. Body wall thin (sometimes transparent) except in anterior and posterior region, usually thinnest on dorsal side. Surface usually wrinkled by large numbers of closely set papillae. Nephridiopores and opening of male tube on antero-ventral surface often very noticeable.

Proboscis: Long, bifid, adherent and capable of much extension; in fixed specimens 1-10 times as long as trunk. Arms shorter (3-10 mm), normally about equal length. Ventral surface ciliated, lateral

edges tending to curve inwards. Mouth at base of proboscis.

Setae: Two (in addition smaller reserve setae usually present), golden brown, slightly iridescent, with free end forming a weak hook. Johnston and Tiegs state that larger hooks are 2-3 mm long and smaller 0.7-0.8 mm and that a strong muscle pad joins their internal ends 'evidently serving to impart to them a lateral pincer-like movement'. The description aptly fits the structure and function of an interbasal muscle. Although there are well developed setal muscles in the present specimens, none clearly show the presence of an interbasal muscle.

Nephridia (gonoducts or uteri): One pair, size variable, usually prominent, tapering distally, each with a slightly frilled, distally placed nephrostome borne on a short stalk. Largest eggs in nephridium 0.25-0.35 mm (Johnston & Tiegs 1919 give 0.11 mm). Nephridiopores on each side of nerve cord in anterior trunk region.

Male tube (androecium): Small, 1.5-3.0 mm long, opening externally near nerve cord at about level of nephridiopores. Opening often very noticeable. Tube encloses small, wormlike male attached to distal end of tube.

Alimentary Canal: Foregut short; midgut long, thin walled and associated for much of its length with an intestinal siphon; hindgut short. No precloacal caecum. Faeces form sub-ellipsoidal pellets.

Vascular System: Thin walled ventral vessel runs alongside of nerve cord. Thin walled dorsal blood vessel (fastened to foregut and body wall by mesenteries) fuses with gut near junction of fore- and mid-gut. Single neurointestinal vessel, arising from wall of midgut just posterior to anteriormost extremity of siphon, joins ventral vessel in anterior half of trunk. Intestinal extremity of neurointestinal vessel usually arises from two short roots which lie on each side of the siphon and in close contact with it. Neurointestinal vessel sometimes vesiculated.

Anal Vesicles: Two branching, tuft-like masses of fine tubes, arising on each side of posteriormost section of hindgut. In this respect they differ from the type description in which 'each anal tree consists of masses of very delicate, simple, cylindrical tubes opening separately into the rectum'. Edmonds (1960, p. 96) remarked that 'the anal vesicles do not seem to communicate with the cloaca as simply as described by Johnston and Tiegs' and that the tubes branch to some extent. The anal vesicles of dissected specimens in the present collection from Queensland and Western Australia are branched. In one of the paratypes (AMS G477), the vesicles arise from about 12 short tubes which branch and sometimes rebranch into simple cylindrical tubules that open to the coelom through slightly dilated funnels fringed with cilia.

Ovaries: Johnston & Tiegs (1919) state that the ovaries arise from the peritoneum lining the muscular strands that hold the posterior portion of the rectum in position and that they lie transversally on the frenulae. In the present specimens developing eggs lie more longitudinally in the posterior third or half of the body cavity in close association with the ventral vessel.

Description of male

According to Johnston & Tiegs (1919) the male lives permanently in the androecium of the female, the two being fused distally. Without definite mouth or anus, although a rudimentary canal is present. No setae. Two seminal vesicles present. How the male performs its sexual function is not known. Johnston & Tiegs (1919) suggest that 'the sperms may be liberated into the cavity of the androecium whence they reach the exterior through its canal and enter the adjacent openings. It is possible, however, that the male may be protruded through the canal of the androecium and actually liberate sperms in the female aperture'.

Systematics

Although the specimens examined in the present collection from North West I. and Heron I. differ in a few respects from the type description, they are considered to be *P. biuterina*.

No satisfactory character has been found that distinguishes any of the Western Australian

bonelliids from *P. biuterina*. Those collected from the CSIRO laboratory at Waterman Bay (from under pots standing on sand in an indoor aquarium through which sea water was continually passed) were pale green while those collected at Heron I. were dark green. How important colour differences are is not known. Agius & Jaccarini (1981) have shown that the unpigmented trochophores of *Bonellia viridis* when kept under constant illumination develop into unpigmented adults. Whether the depth of colour of *P. biuterina* depends on the amount of light received is unknown.

Two other bonelliids closely related to *P. biuterina* have been described from W.A., *Archibonellia michaelsoni* Fischer, 1919 and *Austrobonellia mjobergi* (Fischer, 1921), the former from Rottnest I., the latter from Broome, both localities being places where *P. biuterina* has been found. Both Fischer's species were described from single specimens.

Austrobonellia mjobergi Fischer, 1921, is now being placed in the synonymy of *P. biuterina* Johnston & Tiegs, 1919. Fischer described his specimen thus; trunk oval, 45 mm long, light grey and transparent; proboscis short, 18 mm long, with two arms of unequal length. Setae two with recurved tip, no interbasal muscle. Nephridia two, thin walled (containing eggs) with distally placed nephrostomes and a median, unpaired, smaller, thick-walled 'Segmentalorgan' or 'Uterus', with a basally placed nephrostome. Intestine long and convoluted. Anal vesicle disc-like and expanded with 12-15 dendritic main stems the branches of which possess lateral funnels.

If Fischer's 'Segmentalorgan' is a male tube and if injury accounts for the inequality in the length of the proboscis arms, then the description of *A. mjobergi* fits very well that of *P. biuterina*. Fischer's other specimen from W.A., *Austrobonellia michaelsoni*, differs in other characters and is possibly a separate species.

Specimens examined and localities (these are additional to those recorded in Edmonds, 1960)

Queensland: Heron I. (1) AMS W3719; North West I. (3) AMS W1807, (1) AMS W2691; Whitsunday Group (1) AMS W3029; One Tree I. (1) AMS W9275

Western Australia: Barrow I. (2) WAM 139-83; Riddell Pt, Broome (3) WAM 50-85; Roebuck Bay, Broome (2) WAM 47-85; Abrolhos I. (1) WAM 102-79; Yanchep Reef (2) WAM 98-79; Waterman Bay (CSIRO Marine Laboratory) (10) SAM E1439-1441; Garden I. (1) AMS W3720; Albany (S. side of Princess Royal Harbour) (2) WAM 147-81; Lookout Pt, Cheyne Bay (1) SAM E1482.

Distribution

Queensland: The Great Barrier Reef, from

Capricorn Group in the south to Low I. in the north.

Western Australia: From Barrow I. in the north to Cheyne Bay in the south. Whether the species extends from Queensland to Western Australia through Torres St is not known. It is not known from S.A., Vic., N.S.W. or Tas.

Other record: New Caledonia (Stephen 1976).

Habitat

Specimens have been collected intertidally in coral and limestone reefs; also from under stones and objects resting on sand.

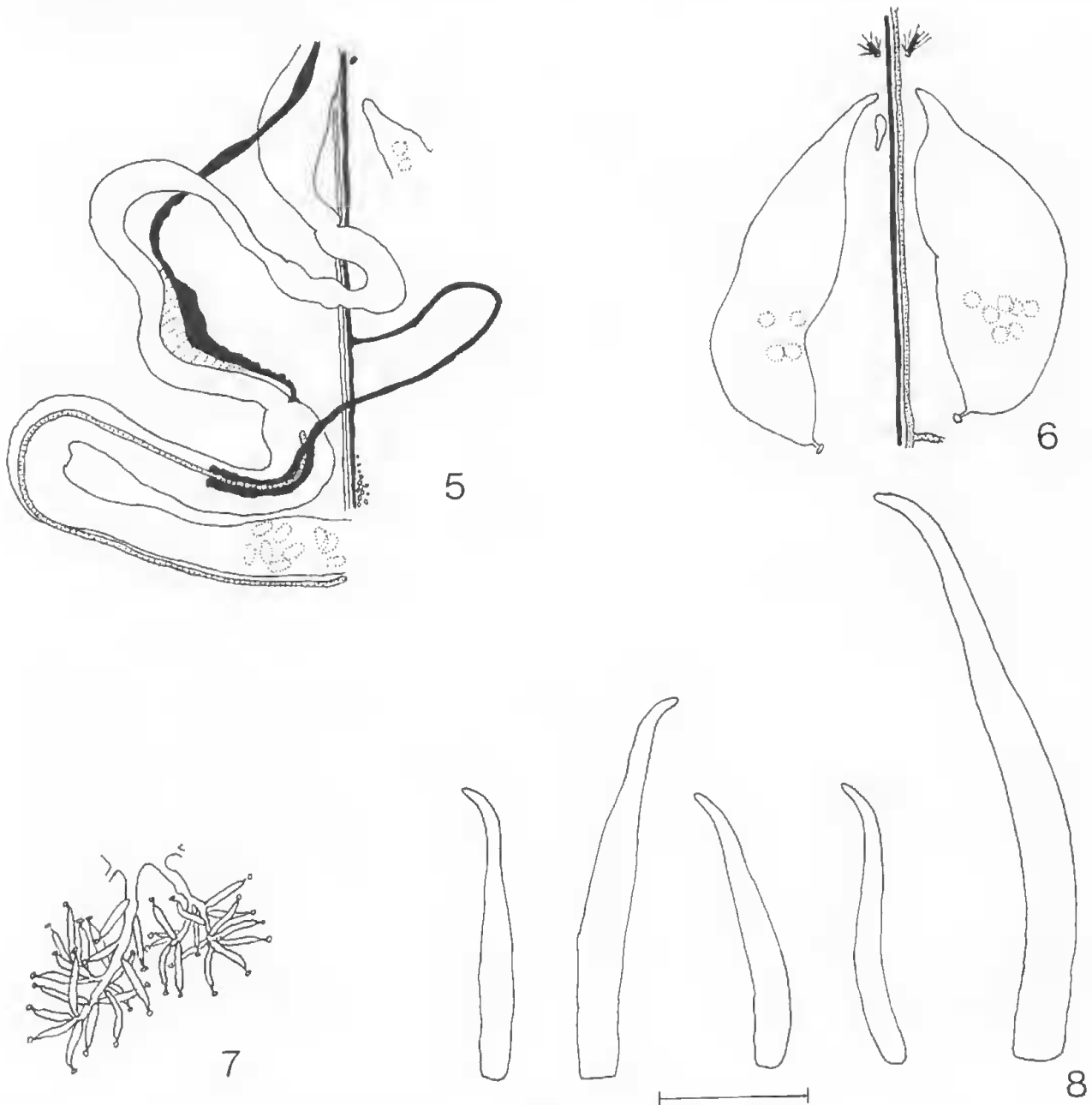
Genus *Archibonellia* Fischer

Archibonellia Fischer, 1919, p. 283; Fisher 1984a, p. 856.

Type-species: *Archibonellia michaelsoni* Fischer, 1919.

Diagnosis

Female with bifid proboscis. Trunk with two ventral setae. Three nephridia, two being paired, lateral and very small and the third median, large and unpaired. Position of nephrostome not known. Intestine very short with globular caecum. Male not described.



FIGURES 5-8. *Pseudobonellia biuterina*. 5, anterior region, digestive and vascular systems; 6, nephridia (gonoducts) and male tube; 7, small portion of anal vesicle; 8, setae from different specimens (scale line = 0.5 mm).

?* *Archibonellia michaelsoni* Fischer

Archibonellia michaelsoni Fischer, 1919, pp. 283-285; 1926, p. 207; Fisher 1948a, p. 856; Edmonds 1960, p. 97.

Type-specimen: Not known; type locality: west coast of Rottnest I., near Fremantle, W.A.

Description of female (after Fischer 1919) (Male not known)

Trunk: About 12 mm long, grey in life. Proboscis anteriorly forms two lappets. Setae two, with reserve pair and an interbasal muscle. Two small, paired nephridia ('Segmentalorgane') placed below a large unpaired 'Uterus'. Intestine very short, consisting of a single loop in anterior half of trunk and a bow-shaped tubular part in posterior half. Globular caecum present. Ovary lies along posterior region of nerve cord. Anal vesicles arise as single stems on either side of rectum and branch at tip. Position of nephrostome not known.

Systematics

A. michaelsoni resembles *P. biuterina* Johnston & Tiegs in many respects, especially in the possession of an unpaired, median 'Uterus' lying between paired lateral nephridia. Moreover, Fischer (1919) thought that he saw a male in the median structure. In *P. biuterina*, however, (1) the lateral nephridia are much larger than the medial tube; (2) the alimentary canal is very long and convoluted and not very short (incredibly short) as shown in Fischer 1919, fig. 6; and (3) neither caecum nor interbasal muscle is present. While the two species may be synonymous the described differences between them are considerable and until the type or more specimens became available it is probably best to consider them as different.

Genus *Protobonellia* Ikeda

Protobonellia Ikeda, 1908, p. 259; Fisher 1948a, p. 854; Datta Gupta 1976, p. 115.

Type-species: *Protobonellia mitsukurii* Ikeda, 1908.

Diagnosis

Proboscis of female long, tubular, non-bifid. Ventral setae two. One nephridium. Nephrostome stalked, fimbriated, basal. Anal vesicles long, dentritic. Male not known.

* *Protobonellia papillosa* Murina

Protobonellia papillosa Murina 1978, pp. 112-113, fig. 4.

Description (after Murina, 1978)

Trunk 28 mm long, 16 mm wide, bearing rounded papillae 0.25-1.25 mm in diameter, densest anteriorly and posteriorly. Proboscis light grey, width 5.5 mm, distally blunted; basal part (near mouth) has form of oval collar with thick, wavy, pigmented borders and two long processes laterally. Setae two, golden-yellow, bent or curved, 0.5 mm long, 0.15 wide. Nephridium single, rounded, lying on right side of nerve cord; nephrostome short, basal. Anal vesicles form dense bushes on each side of rectum. No clearly visible anal rosette.

Specimen and locality

Described from one female specimen collected during cruise of 'Dmitrii Mendeleef', Stn 1245, 30° 24' S, 161° 57' E near Lord Howe I. at 1200 m. No other record.

Genus *Sluiterina* Monro

Sluiterina Monro, 1927, p. 618; Murina 1976, p. 840.

Type-species: *Hamingia sibogae* Sluiter, 1902.

Diagnosis

Proboscis of female non-bifid; lateral edges turn inwards giving structure a tubular appearance; edges fuse near mouth to form a cup. Nephridium single, nephrostome basal. Anal vesicles bushy or brush-like. Male unknown.

* *Sluiterina alba* Murina

Sluiterina alba Murina, 1978, p. 111, fig. 3.

Description (after Murina 1978)

Trunk 44 mm long, 8 mm wide, posterior region damaged. Body wall white, thick and not transparent. Proboscis 12 mm long, 6 mm wide (distal part damaged), with lateral margins folded inwards making it tubular in form. Nephridium single, sac-like, 7 mm long, 3 mm wide, with centrally located nephrostome. About 50 white eggs with diameter 0.12-0.13 mm in cavity of body. Between posterior coils of gut are bunches of bright yellow material, probably remains of anal vesicles.

Specimen and locality

Described from a single female collected during cruise of 'Dmitrii Mendeleef', Stn. 1373, Great Australian Bight, 33° 48' S, 127° 07' E at 1080-1100 m. No other record.

Genus *Vitjazema* Zenkevitch

Vitjazema Zenkevitch, 1958, p. 195; Datta Gupta 1976, p. 115.

Type-species: *Vitjazema ultraabyssalis* Zenkevitch, 1958.

Diagnosis

Proboscis of female non-bifid; anterior region, however, expanded into a slightly widened 'head' with thickened festoons along anterior border; under festoons are triangular flaps directed inside a ventral gutter. Setae two. Nephridia two, nephrostome distal. Anal vesicles sac-like. No male known.

* *Vitjazema ultraabyssalis* Zenkevitch

Vitjazema ultraabyssalis Zenkevitch, 1958, pp. 195-197, fig. 3; Murina 1978, p. 115.

Description

Trunk green, length 14-15 mm. Proboscis 9-27 mm long with deep funnel on ventral side; anterior region widened with festoon-like border consisting of 5-6 triangular lappets. Setae 2, large with bent blades and blunt tips. Nephridia one pair, with distal nephrostomes at end of long tube. Anal vesicles unbranched, covered with small funnels.

Specimens and localities

Two female specimens collected during cruise of 'Dmitrii Mendeleef', Stn 1365, Great Australian Bight, 34° 25'S, 128° 12' 5"E at 3880 m.

Distribution

Kurile - Kamchatka Trench (at 5560-9700 m); Marianne Trench; Great Australian Bight (at 3880 m).

Genus *Zenkevitchiola* Murina

Zenkevitchiola Murina, 1978, p. 108.

Type-species: *Zenkevitchiola brevirostris* Murina, 1978.

Diagnosis

Proboscis long, non-bifid. Trunk without setae. Single nephridium, nephrostome basal. Anal vesicles, two, long, slender, filamentous. Male not known.

* *Zenkevitchiola brevirostris* Murina

Zenkevitchiola brevirostris Murina, 1978, pp. 108-109, fig. 1.

Description (after Murina, 1978)

Trunk 68 mm long, 28 mm wide, anterior third

and posterior quarter covered with low, rounded papillae 1.5 x 0.8 mm. Coils of gut visible through body wall. Proboscis white, transparent with lateral margins turned up or folded, length 65 mm, width 5-7 mm; distal extremity curved and widened, proximal extremity forms cup with a slit on ventral side. Nephridium single, 11 mm long, 5 mm wide, located on right side of nerve cord; anterior region swollen and filled with eggs 0.25-0.3 mm in diameter, posterior half with thicker walls and no eggs. Nephrostome basal, stalked and with rosette at distal end. Anal vesicles two, dark brown, tapering distally. Gut coils 10-12. Anus forms weak rosette, surrounded with small papillae.

Specimen and locality

Described from one female collected during voyage of 'Dmitrii Mendeleef', Stn 1345, near southern Tasmania, 43° 47'S, 147° 51'E at 755 m. No other record.

Genus *Anelassorhynchus* Annandale

Anelassorhynchus Annandale, 1922, p. 148; Fisher 1946, pp. 221-22; 1949, pp. 480-481; Stephen & Edmonds 1972, pp. 443-444.

Type-species: *Thalassema branchiorhynchus* Annandale & Kemp, 1922.

Diagnosis

Proboscis well developed, usually long, never bifid. One pair of ventral setae. Longitudinal, circular and oblique musculature of body wall continuous. Nephridia, 1-3 pairs. Nephrostomal lips long and spirally coiled (thus differing from genus *Thalassema*).

KEY TO AUSTRALIAN SPECIES OF *ANELASSORHYNCHUS*

1. Nephridia, two pairs and post-setal 2
Nephridia, three pairs and post-setal... *A. vegrandis*
2. Trunk globular to ovoidal, sandy-grey to light brown in colour *A. porcellus porcellus*
Trunk sausage-shaped to elongate, green in colour *A. porcellus adelaidensis*

Anelassorhynchus vegrandis (Lampert)

Thalassema vegrande Lampert, 1883, p. 341; Monro 1932, p. 33.

Anelassorhynchus vegrandis Fisher, 1946, p. 222; 1949, p. 481.

Type-locality: Philippines.

Description (after Lampert 1883)

Proboscis lacking. Nephridia three pairs and post-setal. Nephrostomal lips spirally coiled. Anal vesicles long and without ciliated funnels.

Remarks

Monro's specimen from the Barrier Reef was in poor condition and his identification was made with some reservation. The species is not well known.

***Anelassorhynchus porcellus porcellus* Fisher**
(Fig. 20)

Anelassorhynchus porcellus Fisher, 1948b, pp. 274-277, figs 1a-d; Edmonds 1960, pp. 91-92, pl. 1c.

Type-specimen: U.S. Nat. Mus., Washington D.C..
Type-locality: Honolulu, on reef south of harbour.

Description

Trunk: Globular to ovoidal, colour sandy grey to light brown, length 25-40 mm, maximum width 15-29 mm; skin rather thick but wrinkled with numerous flat papillae; musculature continuous. Setae two, golden-brown, lying posterior to mouth; no interbasal muscle present.

Proboscis: Fleshy, readily deciduate, usually tapering anteriorly, 8-20 mm long.

Alimentary Canal: Very long and fragile, filled with fragments of coral, small shells and coral sand (which usually rupture the thin gut wall as soon as one tries to free the intestinal coils); presiphonal section of mid-gut very long.

Vascular System: Consists of dorsal vessel, ring vessel, two neuro-intestinal vessels and a ventral vessel.

Setae: Two pairs, post-setal, with nephrostomal lips long, slender and coiled.

Anal Vesicles: Two long, with small, unstalked funnels. Intestinal siphon present but no precloacal caecum.

Systematics

The specimens from Heron I. correspond closely with two of Fisher's specimens of *A. porcellus* from Kakaoha Reef, Hawaii (U.S. Nat. Mus. part 26423). Fisher was unable to recognise any ciliate funnels on the anal vesicles of his specimens. In the Australian specimens the funnels, though small and sparse, are definitely present. One of Fisher's specimens when dissected was found to possess three pairs of nephridia.

Specimens Examined

Qu: Heron I. (Capricorn Group) (3) SAM E1425; North-West I. (Capricorn Group) (1) AMS W2816; Ingram I. (1) SAM E1431; Brockhurst Reef off Townsville (1) SAM E1494.

Distribution

Western Pacific Ocean at Hawaii and Great Barrier Reef, Qu.

***Anelassorhynchus porcellus adelaidensis* Edmonds**
n. stal.
(Figs 9-11, 21)

Anelassorhynchus adelaidensis Edmonds, 1960, pp. 92-93, pl. 2a.

Anelassorhynchus porcellus (in part) Edmonds, 1982, p. 316.

Type-specimen: AMS; type locality Aldinga Beach, S.A.

Description

A number of specimens which have previously been called *A. adelaidensis* and *A. porcellus* (in part) are now being referred to as a new subspecies, *A. porcellus adelaidensis*. The new subspecies differs from the nominate form in size, colour and distribution.

Trunk: More elongate than nominate subspecies, length 15-90 mm, maximum width 10-40 mm, always light to dark green, surface wrinkled and made verrucose by many, large, flat, white papillae (most numerous anteriorly and posteriorly); secretes copious amounts of mucus making animal very slippery to hold.

Proboscis: Fleshy, readily deciduate, up to 37 mm long, lateral edges may be wavy but never with processes.

Setae: Two golden brown, 2.8-5 mm long, no interbasal muscle (setae lost in some specimens).

Nephridia: Two post-setal pairs (occasionally an extra single nephridium or pair); nephrostomal lips filamentous, weakly to strongly coiled.

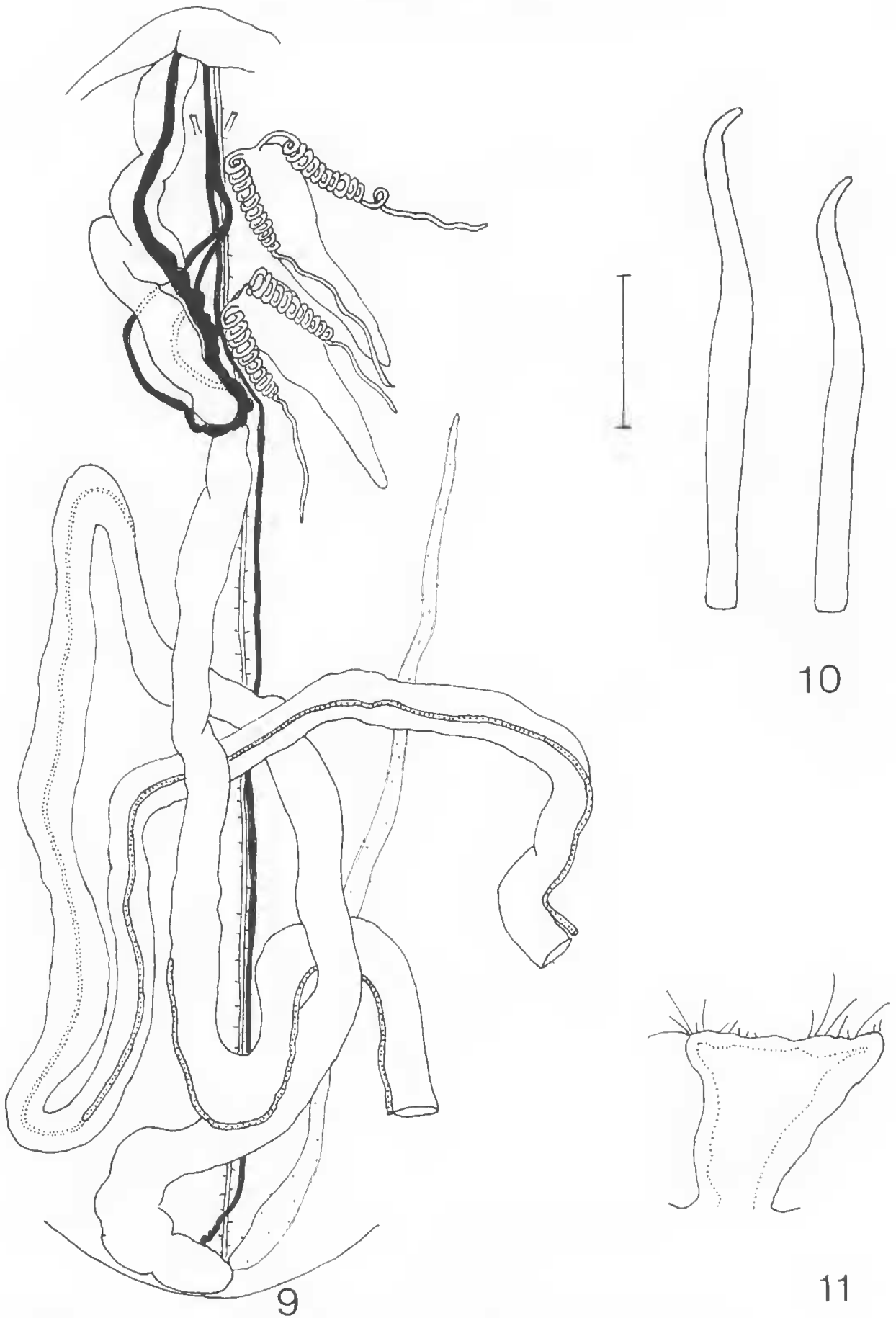
Alimentary Canal: Very long and much convoluted, with very long presiphonal section of mid-gut; faecal matter not in form of pellets; intestinal siphon present but no caecum.

Anal Vesicles: Two, long, thin walled, tubular but usually expanded basally, and attached (especially basally) to body wall by numerous mesenteries or muscles; coelomic surface bears sparsely distributed ciliate funnels and numerous brown spots which appear to be aggregates of very small pigmented granules.

Vascular system: Dorsal, ring, two neurointestinal- and ventral vessels. Hand cut sections of proboscis show two lateral and one median vessel. Well-developed ventral nerve cord extending into proboscis.

Specimens and localities

Victoria: Port Phillip Bay, SAM E1429, Brighton, SAM E1432.



FIGURES 9-11. *Anelassorhynchus porcellus adelaidensis*. 9, dissected specimen; 10, setae (scale line = 1.0 mm); 11, ciliated cup from anal vesicle.

South Australia: St Vincent Gulf-Port Willunga, SAM E1427 (1); Aldinga Reef, SAM E1428 (1); Cape Jervis, SAM E1430 (1); Coobowie, SAM E1454 (1), SAM E1455 (1), SAM E1456 (5), SAM E1461 (3), SAM E1462 (1); Brighton, SAM E1463 (5). Spencer Gulf-at following islands at Banks Group, Winceby I., SAM E1476 (3), Marum I., SAM E1477 (2), SAM E1486 (1), SAM E1493 (3), Lusby I., SAM E1489 (3). Eyre Peninsula-Port Lincoln, SAM E1479 (2); Port Turton Jetty, SAM E1503 (1); Venus Bay (under jetty), Blanche Pt (Streaky Bay), Smokey Bay, (coll. K. Gowlett-Holmes).

Systematics

The internal anatomy of the South Australian specimens corresponds very closely with that of *A. porcellus*. Their shape, however, is more elongate and their colour green. Fisher does not mention the colour of his specimens but specimens of *A. porcellus* collected by the author at Heron I., Qu., were light brown to sandy grey. The green subspecies is commonly collected by divers in S.A. but no brown forms have yet been found in the State. The distribution of the two subspecies consequently seems different. *A. gangae* Bisewar, 1984, recently described from Natal, South Africa and *A. porcellus adelaidensis* are closely related species.

Distribution

Southern Australia from Port Phillip Bay (Vic.) to Streaky Bay (Eyre Peninsula) in S.A.

Genus *Arhynchite* Sato

Arhynchite Sato, 1937, pp. 142-143; Fisher 1946, p. 485; Stephen & Edmonds 1972, p. 414.

Type-species: *Thalassema arhynchite* Ikeda.

Diagnosis

Proboscis long slender, often ribbon-like, sometimes deciduate; anterior extremity expanded into a fan-like structure. Two ventral setae with strong interbasal muscles. Nephridia two, with nephrostomal lips expanded into a leaf-like structure. Anal vesicles long, thin walled and unbranching. Vascular system with or without ring vessel.

Arhynchite hiscocki Edmonds

Arhynchite hiscocki Edmonds, 1960, pp. 90-91, fig. 3, pl. 1, fig. 1b; 1966, p. 178; Stephen & Edmonds 1972, p. 417.

Holotype: AMS W3714; type locality: Dunwich, Qu., 'dug from sand pit, 18" below surface'.

Description

Trunk: Elongate, slender, pencil-like, length 100-120 mm, width 4-6 mm, fixed specimens yellow-brown to grey green. Surface made verrucose by numerous near rows of elevated papillae, slightly larger at anterior and posterior extremities. Musculature continuous.

Proboscis: Delicate, slender, about 30 mm long, 1.5-2.5 mm wide, still attached to trunk in holotype; anterior extremity flattened and fan-like. In one specimen from Victoria proboscis is shorter, deciduate, with anterior extremity more spoon-like.

Setae: Two, connected to body wall internally by strong radiating muscles and to each other by strong interbasal muscle.

Nephridia: Two, sub-cylindrical, slender, length variable; post-setal. Nephrostome basal was expanded, frilled or leaf-like lip.

Alimentary Canal: Midgut with siphon; no precloacal caecum.

Vascular System: Dorsal blood vessel fuses with foregut at posterior extremity of latter; neurointestinal vessel connects with anterior section of midgut near anterior extremity of siphon. No ring vessel observed.

Anal Vesicles: Two, very slender, brown, about one third to a quarter as long as trunk, fastened throughout their length to posterior region of alimentary canal but to body wall over last quarter of their length. Numerous ciliated funnels scattered over their surface.

Systematics

Sato (1937) erected the genus *Arhynchite* for a group of echiurans lacking a proboscis. Fisher (1949), having found two species possessing a long deciduate proboscis, redescribed the genus. The proboscis of the holotype of *A. hiscocki* is still attached but that of one of the Victorian specimens is detached.

The genus contains six species collected from places bordering the Pacific Ocean: *A. californicus* - Monterey (U.S.A.), *A. inamoenus* - Monterey (U.S.A.), *A. pugettensis* Puget Sound (U.S.A.), *A. rugosus* - Shantung (China), *A. arhynchite* - Japan. Some of the species are closely related and difficult to distinguish. *A. hiscocki* is not a well known species and needs re-examination and revision when more species are found.

Specimens and localities

Queensland: Stradbroke I. (Edmonds 1960), AMS W3714 (2)

Victoria: Port Phillip Bay (Edmonds 1966) VM coll. (2)

South Australia: Spencer Gulf, north of Port Lowly, SAM E1524 (1).

Genus *Listriolobus* Spengel

Listriolobus Spengel, 1912, p. 316; Fischer 1926, p. 110; Fisher 1946, p. 233.

Type-species: *Listriolobus bahamensis* (Fischer), (designated by Fisher 1946).

Diagnosis

Proboscis of variable length, truncate but never bifid. Two setae with interbasal muscle. Longitudinal musculature of trunk wall grouped into bands (not always well developed in young specimens). Oblique musculature not banded or fasciculated as in *Ochetostoma*. Nephridia two to three pairs, nephrostomal lips long and spirally coiled. Anal vesicles sac-like to tubular and without branches.

KEY TO AUSTRALIAN SPECIES OF *LISTRIOLOBUS*

- 1. Longitudinal musculature in 7 bands *L. brevirostris*
- Longitudinal musculature in 13 bands *L. sorbillans*

?* *Listriolobus sorbillans* (Lampert)

Thalassema sorbillans Lampert, 1883, pp. 340-341; Augener 1903, p. 349.

Listriolobus sorbillans Fisher, 1946, p. 234.

Type-locality: Philippines.

Australian record: Sydney (coll. Dr Schutte, 1876) in Augener 1903, p. 349.

Description (after Lampert 1883)

According to the type description (based on a single specimen) the trunk is 65 mm long and proboscis 24. Longitudinal musculature in 13 bands. Nephridia three pairs with spirally coiled nephrostomal lips, first pair presetal in position. Setae small. Anal vesicles long, brown, bearing microscopic ciliate funnels. Small rectal caecum.

Augener's description of his single specimen is brief. Trunk about 42 mm long, proboscis 18 mm. Whole body covered with papillae which are smallest in mid-trunk and largest posteriorly. Anal vesicles about two-thirds length of trunk.

Remarks

This Australian record needs confirmation. If the oblique musculature of Augener's specimen was fasciculated then it might have been *Ochetostoma australiense*.

Listriolobus brevirostris Chen & Yeh Chen-Chang (Figs 12-13, 22)

Listriolobus brevirostris Chen & Yeh Chen-Chang, 1958, pp. 273-278, fig. 7 A-D; Stephen and Edmonds 1972, p. 424.

Listriolobus bulbocaudatus Edmonds, 1963, pp. 243-244, pl. 1, fig. 1.

Type-locality: Kiao-chow Bay, Shantung, China.

Description

Trunk: Sub-cylindrical to cigar shaped, length 21-85 mm, maximum width 10-20 mm, fixed specimens light to dark pink. Surface covered with white papillae, lying almost in rows. Posterior extremity may sometimes be modified and expanded into a fleshy, bulbous, conical structure bearing three or four rows of prominent, pointed or mamillate, white or pink papillae. Longitudinal musculature arranged in bundles, often difficult to discern externally. Dissected specimens show seven (eight in one specimen) well spaced longitudinal bands, occasionally weakly developed where the body wall is thin. Oblique musculature between bands of longitudinal musculature continuous and not in fascicles.

Proboscis: Non-deciduate in all specimens. In fixed condition short, stout, 10-16 mm long, 6-12 mm wide. Small papillae on dorsal surface. Lateral margins wrinkled, folded, indented or crenate. No lateral processes as in *Anelassorhynchus branchiorhynchus* Annandale & Kemp.

Setae: Two (with smaller reserve setae), length (measured in straight line from base to tip) up to 7.2 mm, strongly hooked and sickle-shaped. Strong interbasal muscle.

Nephridia: Two post-setal pairs; in one specimen three nephridia on one side and two on other. Length variable, some extending almost to posterior extremity of trunk. Nephrostomal lips long and much coiled.

Alimentary Canal: Long, much coiled. Presiphonal section of midgut long. Precloacal caecum present.

Vascular System: Dorsal vessel expands into a thin walled saccular vessel or heart. Well-developed ring vessel at junction of fore- and midgut gives off two neurointestinal vessels which join before they reach the interbasal muscle and then bifurcate to form a loop around the muscle. Ventral vessel pressed close to nerve cord and terminates in the cloacal caecum.

Anal Vesicles: Long, thin walled, brown, swollen basally in most specimens, bearing numerous, small, ciliated cups some on very short stalks. Anteriorly placed cups more sparsely distributed.

Systematics

These Australian specimens closely resemble *Ochetostoma septemyotum* Datta Gupta, Menon & Johnson, 1963 from Quillon, India. In none of the Australian specimens, however, has the oblique musculature of the body wall been found to form fascicles, like that shown for *Ochetostoma octomyotum* by Fisher 1946, pl. 23, fig. 2, and pl. 24 (in the spaces between muscles labelled MVL, ML and MDL) or like that shown in the transverse sections of *Ochetostoma bombayense* by Mathew 1976, fig. 5.

Because fasciculation of the oblique musculature is a character of *Ochetostoma*, the Australian specimens are considered different from *O. septemyotum*.

Edmonds (1963) originally described the specimens from Queensland as *Listriolobus bulbocaudatus*. At the time he was unaware of *L. brevirostris* Chen & Yeh Chen-Chang (1958) from Kiao-chow Bay, Shantung, China. At a later date Stephen and Edmonds (1972, p. 424) considered the two species were distinguished by three or four rows of prominent papillae and a bulbous structure both present at the posterior region of *L. bulbocaudatus*. More recently the author has examined three specimens from Queensland, in which the rings of prominent papillae and the bulbous structure are much reduced. This information brings the specimens within the range of *L. brevirostris*. Consequently *L. bulbocaudatus* is now considered to be a junior synonym of *L. brevirostris* Chen & Yeh Chen-Chang (1958).

Specimens examined and localities

Queensland: Yeppoon, SAM E1434 (1); Mud L., Moreton Bay, SAM E1433 (1); Round Is, Hervey Bay, SAM E1436 (1); Bramble Bay, SAM E1460 (1); ?Bramble Bay, SAM E1435 (4). Dredged from mud.

Distribution

China at Shantung. Australia: Queensland.

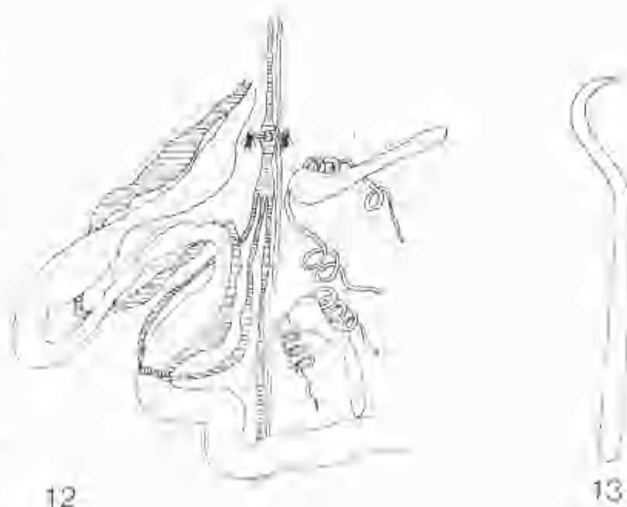
Genus *Ochetostoma* Leuckart & Rueppell

Ochetostoma Leuckart & Rueppell, 1828, pp. 7-8; Fisher 1946, p. 240; Stephen & Edmonds 1972, p. 426.

Type-species: *Ochetostoma erythrogrammon* Leuckart & Rueppell, 1828.

Diagnosis

Proboscis long, capable of much extension, non-bifid. Trunk medium to large with longitudinal musculature lying in well-defined bands. Intervals between bands crossed by numerous fascicles or small bundles of inner oblique musculature (Fisher



FIGURES 12-13. *Listriolobus brevirostris*: 12, anterior region dissected; 13, seta.

1946, pl. 23, fig. 2). Nephridia in one to seven pairs, with long spirally coiled nephrostomal lips. Setae two, with or without interbasal muscles. Anal vesicles long, more or less tubular, unbranched. Rectal caecum usually present.

KEY TO AUSTRALIAN SPECIES OF *OCHETOSTOMA*

1. Longitudinal musculature in 11-13 (11-14) bands; three pairs of nephridia, one pair presetal, two pairs postsetal. Fasciculation of oblique musculature usually well developed. No interbasal muscle *O. australiense*
- Longitudinal musculature in 17-19 (17-21) bands; two pairs of postsetal nephridia. Fasciculation of oblique musculature well developed. Strong interbasal muscle *O. baroni*

Ochetostoma australiense Edmonds (Figs 14-15, 23)

Ochetostoma australiense Edmonds, 1960, pp. 93-94, fig. 4, pl. 2b; Datta Gupta & Menon 1971, pp. 177-178, figs. 2c, 2e.

Type-specimen: AMS; type locality, mud flats at Dunwich (Stradbroke I.), Qu.

Description

Trunk: Usually large, sausage-like, cigar shaped or elongate, pale to dark red, length 40-130 mm, maximum width 15-30. Thickness of body wall variable, sometimes very thin. Surface, especially in anterior and posterior regions, covered by numerous small, flat, fleshy to wartlike papillae. Usually 12-13 (11-14) well developed longitudinal muscles best counted in dissected specimens. In 20 dissected specimens the maximum number of bands was 14 in 3, 13 in 10, 12 in 6 and 11 in one. Two

bands, one on each side of the nerve cord, lie very close together and may appear to be one. Oblique musculature between longitudinal bands usually grouped into numerous fascicles, which may be weakly developed or even absent in parts of some animals.

Proboscis: In living animals is highly extensible (150–200 mm), pale and ribbon-like. In fixed specimens shorter, fleshy, up to 60 mm long, with lateral margins rolled inwards on ventral side. Usually adherent or non-deciduate. Anterior extremity may be flattened somewhat and lateral margins may be slightly wrinkled. No lateral processes.

Setae: Two, 2.5–3.1 mm long (measured in a straight line from tip to midpoint of base), golden, encased in sheath connected to body wall by a number of setal muscles. No interbasal muscle.

Nephridia: Three pairs, the first presetal, others postsetal. Length variable, sometimes over half length of trunk. Nephrostomal lips elongate and spirally coiled, although sometimes only weakly. In one specimen only five nephridia present.

Digestive System: Mouth at base of proboscis. Foregut short, midgut very long and much coiled. Presiphonal section of midgut long and traversed for part of its length by ciliate groove. Siphonal section of gut also long. Well developed caecum present. Gut contents largely mud and sand; no faecal pellets.

Vascular System: Consists of dorsal blood vessel (sometimes well expanded), ring vessel or sinus (may also be expanded), two long neurointestinal vessels and a ventral blood vessel. Two neurointestinal vessels fuse to form one short vessel which joins the ventral vessel at about the level of the setae. Posteriorly ventral vessel gives off a branch to caecum.

Anal Vesicles: Two, long, slender, thin walled, light to dark brown, opening into cloacal region of intestine. Possess small, unstalked ciliate funnels.

Systematics

Edmonds (1960) considered these specimens with 11–14 muscle bands to be different from *O. erythrogrammon* Leuckart & Rueppell which possess 14–18 muscles. *O. erythrogrammon* and *O. australiense*, however, are closely related. The neurointestinal vessel of all the Australian specimens examined in the present study is double for most of its length. Datta Gupta & Menon (1971) state that the corresponding vessel in their specimens of *O. erythrogrammon* is single. If this difference always exists, it further distinguishes the two closely allied species. Sato (1939, fig. 9), however, shows two neurointestinal vessels for his specimens of *O. erythrogrammon*.

Stephen & Edmonds (1972) list nine species of *Ochetostoma* that possess three pairs of nephridia and in which the number of longitudinal muscles varies from 12 to 22. Wesenberg-Lund (1939) and Sato (1939) considered that they were conspecific. If they are correct then *O. australiense* would become *O. erythrogrammon*.

Specimens examined and localities

Queensland: Dunwich (in mud flats in front of cemetery) SAM E1410 (4) and E1411 (1); Caloundra (dug at low tides from mud flat; opposite a small mangrove island) SAM E1415 (7); Myora (in mud flats at low tide) SAM E1413 (20).

New South Wales: Goodwood I. (near mouth of Clarence River) AMS W3186, W3375, W3817; Brunswick Heads (1) AMS coll.

Habitat

At Goodwood I., the worms are found 'between high and low water marks in rather dark sand situated close to some small mangrove clumps. The proboscis is white and fleshy and protrudes from a hole in the sand. It lies along the surface of the sand and is about 6" long and 1/2" wide. In this condition it appears to be quite flat (like a ribbon) and does not appear to take on a tube-like shape as in preserved specimens. The body of the worm is soft and bright red in colour. Twelve longitudinal muscles show up clearly' (P. Durie pers. comm.).

Distribution

Eastern Australia from Caloundra (Qu.) to Goodwood I. (N.S.W.), Andaman I. (Datta Gupta & Menon, 1971). An inhabitant of intertidal mud flats.

Ochetostoma baronii (Greeff)

(Fig. 24)

Thalassema baronii Greeff, 1879, pp. 141–152, pl. 6, figs 62–67.

Ochetostoma baronii Mackie, 1961, p. 247; Stephen & Edmonds 1972, p. 429; Amor 1976, p. 123–124. *Ochetostoma myersae* Edmonds, 1963, pp. 245–246, pl. 1, fig. 2.

Previous Australian record: N.S.W. (Edmonds 1963).

Description

Trunk: Small to moderately large, sac-, sausage- or cigar-shaped, length 21–70 mm, maximum width 9–25 mm; anterior region rounded, posterior sometimes almost pointed. Green. Surface covered with soft, almost white, slightly elevated, wart-like papillae, largest in posterior region of trunk. Longitudinal musculature in 18–19 (21 in one specimen) bundles. Oblique musculature between

longitudinal muscles forms fascicles which sometimes are only weak.

Proboscis: In preserved specimens about half to fifth length of trunk, either deciduate or non-deciduate. Lateral margins tend to roll inwards so as to form a tube. Plump and almost conical in largest specimen.

Setae: Two, up to 3.1 mm long, golden, connected by strong interbasal muscle.

Alimentary Canal: Mouth at base of proboscis. Gut much coiled and filled with coral and shell fragments; obviously animal is able to ingest larger particles than *Ochetostoma erythrogrammon* and *Bonellia viridis* (Chuang 1962, Jaccarini & Schembri 1977).

Nephridia: Two post-setal pairs, nephrostomal lips long, weakly or strongly coiled. Largest ova 0.09–0.11 mm in diameter.

Anal Vesicles: Two, very large, slender, tapering distally and bearing numerous, small, brown unbranched ciliate cups or funnels.

Vascular System: Dorsal blood vessel, ring vessel, two neuro-intestinal vessels and ventral vessel. Neurointestinal vessels long but fusing to form one short vessel which joins ventral vessel at about level of setae.

Systematics

Ochetostoma myersae Edmonds, 1963, was described from N.S.W. as possessing 18–21 longitudinal muscles, two pairs of post-setal nephridia and unbranching ciliate funnels. At the time the species was considered to be different from *O. baronii* (Greeff) in which the ciliate funnels were described as being branched, a fact confirmed by Fischer (1895: 19).

Amor (1976, p. 123), however, after studying specimens collected at Canary Is (type locality), Brazil and Galapagos Is. found that 'amongst the 38 specimens examined there did not exist any branched outgrowths in the anal vesicles'. The examination of three specimens of *O. baronii* from Arrecife, Canary Is, collected by A.K. Totten and identified by A.C. Stephen (B.M. 11.7.7.37). confirms Amor's finding that the funnels are unbranched.

In view of this evidence (especially as Amor examined 38 specimens) the statements of Greeff and Fischer about the branching of the ciliate funnels are questionable. Consequently the chief reason given by Edmonds (1963) for separating *O. myersae* and *O. baronii* is now invalid and *O. myersae* becomes a junior synonym of *O. baronii*. Amor (1976: 123) also considers *O. edax* Fisher, 1946 and *O. kefersteini* (ten Broeke, 1925) as junior synonyms of *O. baronii*.

O. punicea (Dartnall, 1976) is very closely related to *O. baronii* if the ciliated funnels of the latter are unbranched. *O. punicea* has 18–19 longitudinal

muscles, fasciculated oblique musculature, setae about 2.25 mm long, two pairs of post-setal nephridia with spirally coiled lips and anal vesicles with unbranched ciliate cups. No interbasal muscle, however, is present and the left anal vesicle is not symmetrically placed in relation to the right. Whether the last character is taxonomically significant is doubtful. The species was described from Great Tulear Reef, off south-west Madagascar.

Specimens examined and localities

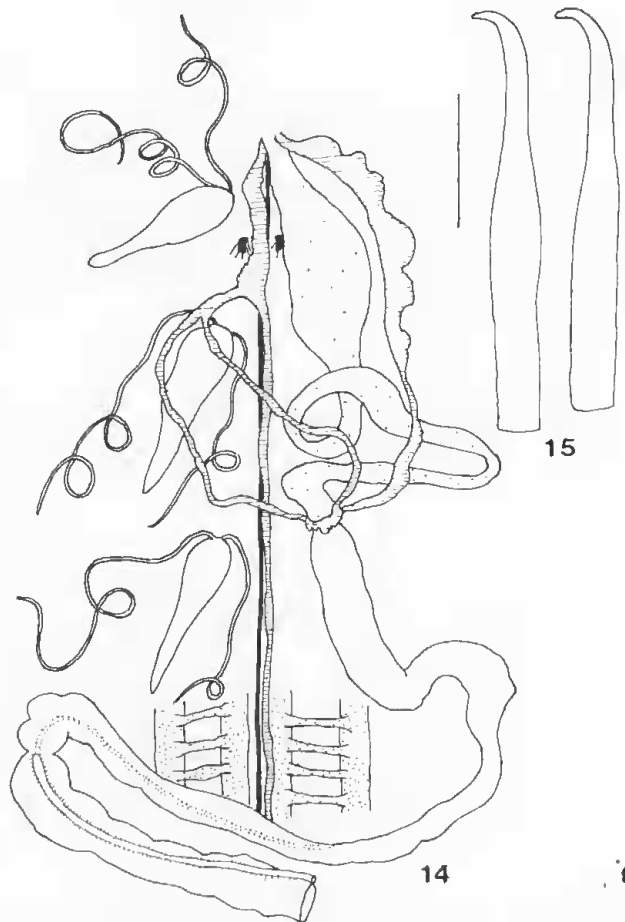
New South Wales: Long Reef (near Sydney) (1) AMS 3357; Collaroy, AMS W3368 (1); Minnie Waters, 'intertidal region of low tide' AMS coll. (1).

Queensland: Bird I. (Moreton Bay) (1) SAM E1417.

Distribution

Eastern Australian from Sydney (N.S.W.) to Moreton Bay (Qu.).

Extra Australian, wide: Atlantic Ocean (Canary I., Bermuda, West Indies, Senegal, Florida, Brazil); Indian Ocean (Zanzibar, Amboina); Pacific Ocean (Papua, Loyalty I., Galapagos).



FIGURES 14–15. *Ochetostoma australiense*. 14, anterior region dissected; 15, setae (scale line = 1.0 mm).

Genus *Thalassema* Lamarck

Thalassema Lamarck, 1801, p. 28; Fisher 1946, p. 230; Stephen & Edmonds 1972, p. 452.

Type-species: *Lumbricus thalassemus* Pallas, 1776 = *Thalassema thalasseum* (Fisher, 1946).

Diagnosis

Echiuridae with well developed, long, non-bifid but usually truncated proboscis. Two ventral setae; lacking anal setae. Longitudinal, circular and oblique musculature continuous. Nephridia in one or two pairs; nephrostome basal and nephrostomal lips neither elongated nor spirally coiled.

Thalassema sydniense Edmonds
(Figs. 16-17)

Thalassema sydniense Edmonds, 1960, p. 89-90, figs. 1-2, pl. 1a.

Holotype: AMS G11219; off Watson Bay, Sydney, N.S.W.

Description (based on four specimens reported in Edmonds, 1960 and two additional ones)

Trunk: Small, grey-brown, sausage to sub-ovoidal; length 2.5-8 mm (most about 5), width 1-2.7. Surface covered with papillae, lying almost in rows and largest posteriorly. Musculature continuous.

Proboscis: Firmly attached, as long as trunk or less, becoming narrower anteriorly.

Setae: Two, golden brown, 1.0-1.1 mm long, with strongly recurved tip; strong interbasal muscle and well developed system of setal muscles.

Nephridia: Two pairs, post-setal. Nephrostome on short stalk near proximal extremity of nephridium; lips expanded but not elongate or spirally coiled. One specimen with only 3 nephridia.

Alimentary Canal: Very long, intestinal siphon present but no caecum.

Anal Vesicles: Two, expanded towards base; surface with ciliated cups.

Systematics

These specimens resemble *Thalassema steinbecki* Fisher, 1946, which occurs along the Pacific coast of North America from California to Ecuador and which has also been reported from the Indian Ocean (Datta Gupta 1975). *T. sydniense* differs from *T. steinbecki* because its nephrostomes are on short stalks or peduncles. *T. sydniense* is known only from six specimens, four of which are very small. It is not a well known species and needs redescription when more specimens become available. Whether the species is a small one or

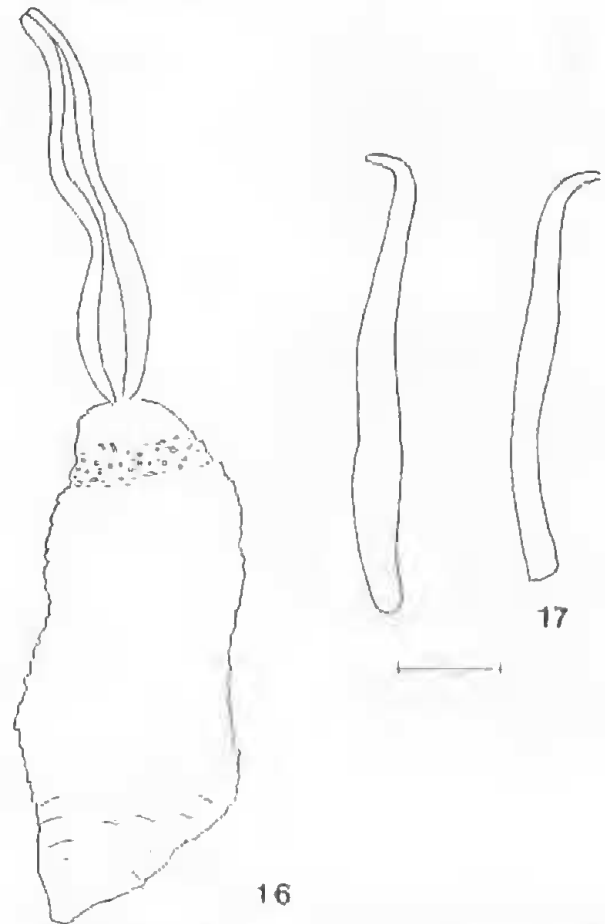
whether the specimens so far collected are simply small ones is not known.

Specimens examined and localities

New South Wales: Watson Bay, AMS G11219 (4).

Victoria: 40° 39'0"S, 144° 56'E (Bass St Survey) MV G3386 (2).

No other records.



FIGURES 16-17. *Thalassema sydniense*, 16, entire animal (scale line = 1.00 mm); 17, seta (scale line = 0.25 mm).

Genus *Ikeda* Wharton

Ikeda Wharton, 1913, pp. 260-261; Fisher 1946, pp. 220; Stephen & Edmonds 1972, pp. 471-472.

Type-species: *Thalassema taenioides* Ikeda, 1904.

Diagnosis

Trunk very long with longitudinal musculature thickened to form bands. Proboscis very long, non bifid. Nephridia very numerous and unpaired.

Ikeda sp.

The very long proboscis of an echiuran has been noticed and collected a number of times by divers

in St Vincent Gulf, S.A. [Edmonds 1982, pl. 23 (4)]. They report that the organ is able to extend for more than 1.5 m. The echiuran itself, however, has proved very difficult to collect on account of the depth of its burrow and the problem of digging in sand at depths of 6–10 m. So far only one specimen has been collected. Unfortunately, it was considerably damaged so that only a limited amount of information can be given about it. Several intact probosces of other specimens have been collected.

The worm resembles in some respects *Ikeda taenioides* (Ikeda, 1904), known from six Japanese specimens. A specific identification of the specimen from S.A. is not possible on account of the damage to its nephridial and anal regions. I am, however, tentatively assigning it to the genus *Ikeda*.

Description

Trunk: Long, slender, worm-like, rather flat in preserved condition; 290 mm long, 7–11 mm wide, pinkish-brown when collected but dark brown when fixed. Longitudinal musculature grouped in 5 bands prominent externally; numerous small sub-globular papillae cover surface of much of trunk.

Proboscis: Flat, about 400 mm long, 5–10 mm wide, with margins in fixed specimens slightly frilled; one surface cream-brown in colour marked with almost transverse brown-black stripes; posterior region of proboscis (near mouth) modified to form cup-like structure.

Setae: Two, about 10 mm long, with well developed setal muscles. Nephridial region much damaged.

Anal Vesicles: Missing.

Alimentary Canal: Very long and convoluted. Some eggs with maximum diameter 0.35–0.38 mm entangled in gut.

Specimens examined and localities

'Kemps Ground', off Glenelg, St Vincent Gulf, S.A., at 9–10 m, 13 March, 1986, one spec. coll. N. Holmes and S. Parker; SAM E1509; separate probosces of other specimens SAM E1587. Coffin Bay (near Black Springs), Eyre Peninsula, S.A. (probosces only).

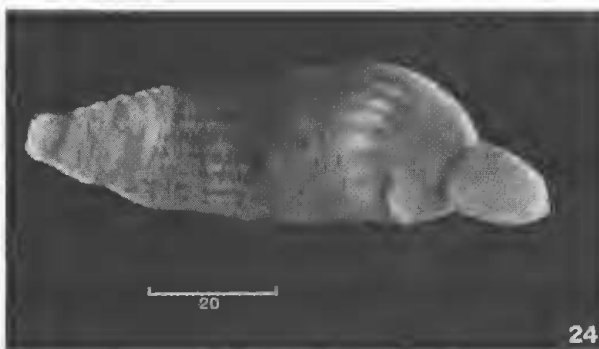
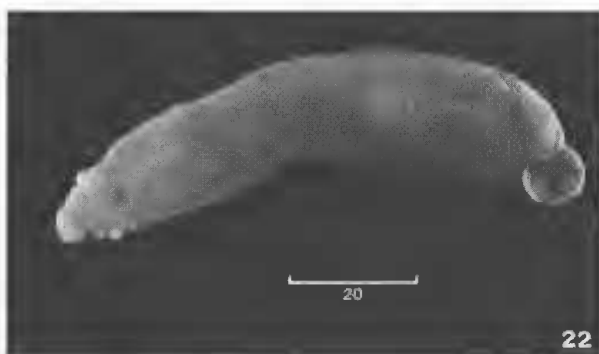
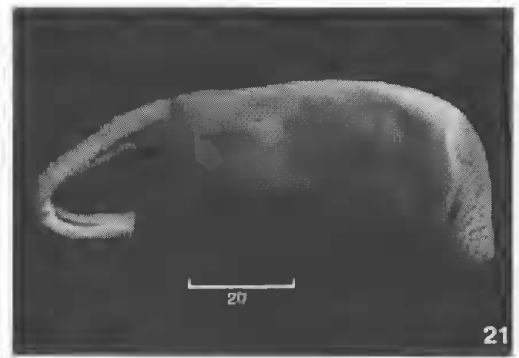
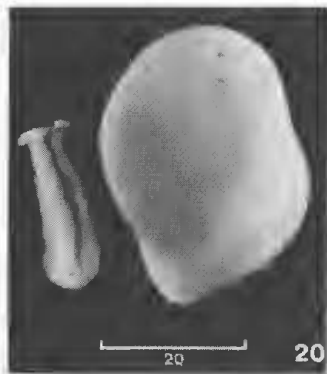
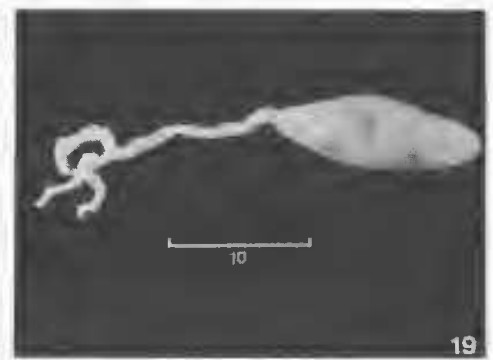
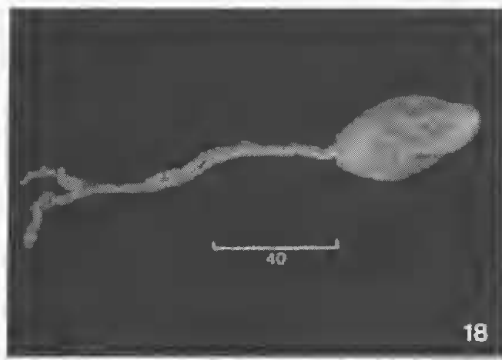
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FIGURES 18-24. 18, *Metabonellia haswelli*; 19, *Pseudobonellia biuteringa*; 20, *Anelassorhynchus porcellus porcellus*; 21, *Anelassorhynchus porcellus adelaidensis*; 22, *Listriolobus brevirostris*; 23, *Ochetostoma australiense*; 24, *Ochetostoma baroni*.